CITY OF LINCOLN, NEBRASKA, STANDARD SPECIFICATIONS

Chapter 23

WATER MAINS

CHAPTER 23

WATER MAINS

23.00 GENERAL

The work covered in this chapter includes the materials, appurtenant devices, water services, installation and testing of water main construction and reconstruction.

23.01 RELATED ITEMS SPECIFIED ELSEWHERE

Chapter 11 Portland Cement Concrete
Chapter 20 Construction for Utilities and Structures
Chapter 22 Sanitary Sewers

23.02 MATERIALS AND SERVICES PURCHASED FROM THE CITY

The Contractor shall purchase the following materials and services from the Lincoln Water System:

- Valves
- Valve boxes, rings and lids
- Fire hydrants ensuring model and configuration for proper nozzle orientation
- Hydrant extensions and installation of extensions
- Hydrant orientation when required
- Pressure taps and abandonments, including tapping sleeves and valves, corporation stops, and all labor and equipment for installation or abandonment
- Flushing and disinfection services and materials
- Operation of valves including applicable fees for water main shutdowns and disruption of service when applicable

The above materials are available for inspection at the Lincoln Water System Shop. The Contractor shall provide all labor and transportation for loading and hauling of said materials.

Water will be supplied to the Contractor in accordance with the General Conditions and Title 17 of the Lincoln Municipal Code.

All materials and services will be billed to the Contractor at prices and rates established by the Public Utilities Business Office. Contractors may obtain the current material prices, labor and equipment rates from the Public Utilities Business Office.

23.03 CONTRACTOR SUPPLIED MATERIALS

A. REFERENCED STANDARDS

1. American National Standards Institute (ANSI). All referenced standards shall be the latest revision thereof

    a. A21.51 - American National Standard for Ductile Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.

    b. A21.10 - Gray Iron and Ductile Iron Fittings, three-inch through 48-inch, for Water and Other Liquids.

    c. A21.11 - Rubber Gasket joints for Cast Iron and Ductile Iron Pressure Pipe and Fittings.

    d. A21.15 - Flanged Cast Iron and Ductile Iron Pipe with Threaded Flanges for Cast Iron and Ductile Iron Pipe and Fittings for Water.

    e. A21.4 - Cement-Mortar Lining for Cast Iron and Ductile Iron Pipe and Fittings for Water.

    f. A21.5 - Polyethylene Encasement for Gray and Ductile Cast Iron Piping for Water and Other Liquids.

    g. B16.1 - Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800.

    h. A21.53 - Ductile Iron Compact Fittings, three-inch through twelve-inch, for water and other liquids.

2. American Water Works Association (AWWA)

    a. C301 - Prestressed Concrete Pressure Pipe, Steel Cylinder Type, for Water and Other Liquids.

    b. C651- Disinfection Water Mains.

    c. C900 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 Inch Through 12 Inch for Water Distribution.

    d. C905 - Polyvinyl Chloride Pipe (PVC) Pressure Pipe and Fabricated Fittings, 14 Inch Through 48 Inch for Water Distribution

3. American Society for Testing and Materials (ASTM)

    a. A615 - Specifications for Deformed and Plain Billet-Steel.

    b. A617 - Specifications for Axle-Steel Deformed and Plain Bars for Concrete Reinforcement.

    c. B88 - Specification for Seamless Copper Water Tube

B. JOINT TYPES

1. Push-on joints shall conform to the requirements of ANSI A21.11 for ductile iron pipe and "Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe ASTM F477 for Polyvinyl Chloride Pipe.

2. Mechanical joints shall conform to the requirements of ANSI A21.11. Bolts and nuts for mechanical joints shall be high-strength, low alloy steel as described in Paragraph 11-6.5 of ANSI A21.11.

3. Restrained push-on joints shall conform to the performance requirements as described in Section 11.9 of ANSI A21.11.

4. Special mechanical joints shall conform to the following:

   a. Swivel couplings (anchoring couplings) shall mean a standard plain end connection with an integrally cast compression gland and freely rotating bolt ring bearing on the compression gland, designed to mate with a standard mechanical joint connection and to prevent the joint from separating under pressure when all bolts are in place. Swivel couplings shall be similar to Tyler Pipe swivel adapter or U.S. Pipe rotatable mechanical joint gland. The rotatable bolt ring portion of swivel couplings shall be fabricated from ductile iron and shall have the letters "D.I." or the words "Ductile Iron" cast in the bolt ring.

   b. Solid couplings shall mean a standard plain end connection with an integrally cast compression gland and bolt ring, designed to mate with a standard MJ bell and gasket. Solid couplings shall be similar to Tyler Pipe solid gland or U.S. Pipe integral mechanical joint gland.

   c. All retainer glands shall utilize a wedge action principle to fully restrain the fitting and pipe together. Wedge action retainer glands shall be EBAA Iron Sales "Megalug", Tyle Pipe MJR Gland, Romac Industries GripRing, or approved equal. Retainer glands shall be fabricated from ductile iron and shall have the letters "DI" or the works "Ductile Iron" cast into the gland.

      Retainer glands shall be supplied clearly tagged or otherwise marked for use with either PVC or Ductile Iron pipe depending on the pipe material being used.

      Retainer glands shall use the following minimum number of wedges for each pipe size and pipe material shown below:

Nominal Pipe Size (inches)	Minimum wedges per gland PVC Pipe	Minimum wedges per gland Ductile Iron Pipe
6	6	3
8	6	4
12	8	8
16	12	12
24	16	16

B. JOINT TYPES (Continued)

5. Flange connections shall conform to the requirements of ANSI B16.1 for 125-pound class and shall also conform to ANSI A21.15. The flange gaskets shall be 1/8 inch thick red rubber. The gasket shall be of the full face or inside bolt ring coverage styles. Bolts shall be sufficient length to expose 1/4 to ½ inch of the bolt beyond the outer face of the nut when the joint is fully assembled.

6. Precast concrete cylinder pipe joints shall conform to AWWA C301. The joint rings shall be galvanized steel. The external joint filler material shall be cement impregnated polyurethane foam in a closed loop form equal to Mar Mac Flex-Protex or shall be a cement mortar grout composed of one (1) part Portland or mortar cement to two (2) parts sand and sufficient water to flow easily. Joint diapers shall be heavy-duty cotton with wire or steel straps in the hem. Diapers shall be a minimum of 6 inches wide for all pipes 36 inches in diameter or smaller. All diapers for pipes larger than 36 inches shall be a minimum of 7 inches wide.

C. GASKET MATERIAL

All gaskets, with the exception of gaskets for flanged joints, shall be neoprene or other synthetic rubber. Natural rubber gaskets are not acceptable.

D. JOINT LUBRICANTS

All joint lubricants shall be a vegetable soap base or equal and shall be supplied by the pipe manufacturer. Lubricants shall be supplied in sterile, tightly sealed, small quantity containers. Any lubricant which has been contaminated with dirt or other foreign material shall be rejected.

E. DUCTILE IRON PIPE

Ductile iron pipe shall conform to the requirements of ANSI A21.51. All pipe shall be Class 52 unless otherwise specified. The cement mortar lining shall be standard weight and shall conform to the requirements of ANSI A21.4. Unless otherwise specified, all pipe shall be supplied in 18 or 20 foot lengths and shall have push-on type joints.

F. PRESTRESSED CONCRETE CYLINDER PIPE

Prestressed concrete cylinder pipe shall be manufactured in accordance with AWWA C301 and shall be designed in accordance with Appendix A or Appendix B of that Specification. Pressures and external loads used in design shall be as specified elsewhere in the Contract Documents.

The Contractor shall supply the following information for approval prior to delivery of the pipe and appurtenances:

1. Design Calculations
2. Proof of Design Test Results
3. Tabulated Layout Schedule
4. Affidavit of Compliance

Fine aggregate shall be clean natural sand. Artificial or manufactured sand shall not be used.

All branch outlets and other connections shall be of the joint type shown on the plans. Where projects are terminated without connecting to existing pipe, a mechanical joint bell adapter and mechanical joint plug shall be provided.

Adapter section shall be provided to connect to valves, fittings and existing pipe. All adapters, fittings and other specials shall be cement mortar lined.

G. POLYVINYL CHLORIDE (PVC) PIPE

Polyvinyl Chloride (PVC) pipe shall conform to AWWA C900 or C905. All pipe 12 inches in diameter or smaller shall be PVC 1120 DR 14 with O.D. conforming to that of cast iron pipe unless otherwise specified. PVC pipe larger than 12 inches in diameter shall be PVC 1120 DR 18 conforming to that of cast iron pipe unless otherwise specified. Joints shall be push-on type with rubber compression ring joints conforming to "Standard Specification for Elastomeric Seals (Gaskets) for Joint Plastic Pipe" ASTM F477.

H. CAST IRON AND DUCTILE IRON FITTINGS

Cast iron and ductile iron fittings shall conform to the requirements of ANSI A21.10 and shall be supplied with a standard weight cement mortar lining conforming to ANSI A21.4 and all necessary glands, bolts, nuts and gaskets to complete a non-restrained mechanical joint fitting connection. Ductile iron compact fittings shall be in accordance with ANSI A.21.53. All joints shall be mechanical joint bells unless otherwise provided in the Contract Documents.

Pressure ratings for fittings shall be a minimum of 250 p.s.i. water working pressure for 12 inch nominal diameter and smaller, based on the diameter of the largest bell. For fittings larger than 12 inch nominal diameter, a pressure rating of 150 p.s.i. shall be used unless otherwise specified.

I. ANCHORING COUPLINGS AND FITTINGS

Anchor couplings shall consist of a length of pipe with a solid coupling end connection and a swivel coupling end connection. Anchor couplings shall be similar to Tyler Pipe adapter swivel fittings or U.S. Pipe hydrant connection pieces.

Anchor elbows shall consist of nine (90) degree elbow with two (2) swivel couplings, Anchor elbows shall be similar to the Tyler Pipe Swivel x Swivel 90 degree ELL swivel fittings.

Anchor pipe shall consist of a length of pipe with two (2) swivel coupling end connections.

Swivel tees shall be cast to the requirements of ANSI A21.10 with mechanical joint run end connection and a swivel coupling on the branch connection. Swivel tees shall be similar to Tyler Pipe MJ x MJ x swivel tees or U.S. Pipe valve and hydrant tees.

J. RESTRAINT COLLARS FOR VALVES AND REDUCERS

Restraint collars for valves and reducers when using PVC for water main construction shall be supplied and constructed in accordance to the applicable Lincoln Standard Plans or contract Special Provisions. Restraint collars for valves and reducers shall be considered subsidiary to PVC Water Main construction and are not measured or paid for as a separate fitting for purposes of this Chapter.

K. CONCRETE AND REINFORCING STEEL

Concrete shall be L3500 conforming to Chapter 11 of these Specifications. Reinforcing steel shall conform to “Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement” ASTM Designation A615, Grade 40 or 60, or “Standard Specification Axle-Steel Deformed and Plain Bars for Concrete Reinforcement” ASTM Designation A617, Grade 60.

L. POLYETHYLENE ENCASEMENT

Polyethylene encasement shall be Class C, black pigmented, 8 mils. thick, linear low density, polyethylene conforming to the requirements of ANSI A21.5. The encasement may be supplied in flat sheets or tubes at the Contractor's option. Tape used to repair or patch the encasement shall be manufactured from synthetic materials. Duct tape shall not be used for repairs. The tubes, measured when laid flat, and the flat sheets shall conform to the following dimensions:

Nominal Pipe Diameter (inches)	Polyethylene Encasement Tube and Sheet Widths (inches)	
	Tube	Sheet
6	20	40
8	24	48
2	30	60
16	37	74
24	54	108
30	67	134
36	81	162
48	108	216
54	121	242

M. COPPER SERVICE PIPE

Copper water service pipe shall be Type "K" seamless soft-drawn copper tubing which conforms to the "Specifications for Seamless Copper Water Tube", ASTM Designation B 88.

N. SERVICE PIPE CONNECTORS

All copper service pipe connectors shall be fabricated from red brass. All copper supply and service pipe shall be joined by either flared-end connectors or brazed, non-lead, eutectic joints.

O. HYDRANT DRAIN MATERIAL

Hydrant drain material shall be clean, washed, uniformly graded pea gravel conforming to the following gradations:

Sieve Size	% of Aggregate Coarser than Stated
½"	0
#4	90
#8	95

P. AIR RELIEF VALVES

Air relief valves shall be provided by the Contractor to conform to the size, type and configuration shown on the plans.

Q. TRACER WIRE

Wire used for locating PVC pipe shall be THNN 14 gauge copper.

All splices and connection shall be made using direct bury 100% waterproof connectors.

23.04 REMOVED MATERIALS

When called for on the plans and Contract Documents, the Contractor shall remove water main pipe and dispose of it.

When called for on the plans, the Contractor shall remove and reset water main valves, hydrants, and plugs at the location and grade as indicated on the plans. The Contractor shall exercise care in the removal and resetting of these items. The Contractor shall thoroughly examine each appurtenance to ascertain whether it is in proper working condition; and if there is a question regarding the condition of the appurtenance, the Contractor shall contact the Lincoln Water System to exchange the item for one that is working.

When called for on the plans and Contract Documents, water main valves, hydrants, and plugs shall be removed and salvaged. The Contractor shall deliver the salvaged appurtenances to the Lincoln Water System Shop. Receipts for salvaged materials shall be delivered to the Project Manager or the observer.

BASIS OF PAYMENT

Water main pipe removed in accordance with these Specifications and accepted by the Project Manager shall be measured and paid for at the contract unit price bid per linear foot for REMOVE ___ FEET OF WATER MAIN. Such payment shall be full compensation for all excavation, removal, backfill, disposal of excess materials, equipment, tools, labor and incidentals necessary to perform the work called for.

Water main valves, hydrants and plugs removed and relayed, removed and salvaged, or removed in accordance with these Specifications and accepted by the Project Manager shall be measured and paid for at the contract unit price bid per each for REMOVE AND SALVAGE _____, REMOVE AND RESET _____, or REMOVE _____. Such payment shall be full compensation for all excavation, removal of appurtenances and thrust blocking, bedding or foundation rock if required, resetting, loading of salvaged items, resetting valve box, backfill, materials, equipment, tools, labor and incidentals necessary to perform the work.

23.05 HANDLING AND STORAGE

The Contractor shall protect all material from damage and handle material carefully in accordance with the manufacturer's recommendations. Equipment used to handle material such as slings, lifting lugs, hooks and other devices shall be designed to protect pipe, coatings, linings, joint elements, castings, valves, hydrants, and all other material.

Gaskets shall be protected from deterioration and stored out of direct sunlight for prolonged periods and in such a manner that they will not contact oils, fumes, solvents, and other materials and substances that attack rubber or synthetic rubber materials.

All hydrants and valves shall be protected so that latent water within the valves or hydrants will not freeze. The hydrants and valves shall be stored in such a manner that water will not enter drains and other openings. All butterfly valves shall be stored indoors. All resilient seated wedge valves shall be stored indoors or with the wedge in a raised position. All pipe, fittings, valves and hydrants shall be kept clean and protected from contamination by mud and dirt.

Prestressed concrete cylinder pipe shall not be stacked higher than allowed by the manufacturer's recommendations. PVC pipe shall not be stacked higher than 8 feet or in accordance with manufacturers recommendations whichever is less. Ductile iron pipe shall not be stacked higher than allowed in the following table:

Pipe Size (inches)	Maximum Number of Tiers
6	13
8	11
12	9
16	7
24	5
30	4
36	4

No direct measurement or payment for storage and handling of materials used in the construction of water mains will be made. The costs associated with the materials to be incorporated into the work shall be considered subsidiary to the items for which direct payment is made.

23.06 EXCAVATION AND BACKFILL

Excavation and backfill for water mains and appurtenances shall conform to the requirements of Chapter 20 of these Specifications except as hereinafter modified for water main construction.

Unless otherwise shown on the plans, modified by Special Provisions, or directed by the Project Manager, all PVC pipe shall be embedded with approved materials to at least 4 inches above the top of the pipe.

23.07 INSTALLATION OF PIPE AND FITTINGS

A. GENERAL

The Contractor shall use the proper tools and equipment necessary to safely install all pipe, fittings and appurtenances to the lines and grades as shown on the plans. Installation of pipe and fittings shall be in accordance to manufacturer's requirements and instructions except where otherwise provided in the specifications. Prior to beginning work, the Contractor shall submit to the Project Manager a copy of the manufacturer's installation instructions for review and approval. The Contractor shall retain a copy of the installation instruction at the project site for reference during construction.

B. CUTTING PIPE

1. Ductile Iron Pipe

When nonstandard lengths of pipe are required to install valve and fittings, terminate lines, or make connections, the Contractor shall cut the pipe using an abrasive wheel, milling type cutter, or other approved mechanical cutter. Torch cutting shall be used only with specific permission of the Project Manager and then only in strict conformance with the manufacturer's recommendations. After cutting, the Contractor shall bevel the ends of the pipe to approximate the manufactured bevel of a full length of pipe. Pipe which is not cut square or which has rough and jagged edges that might nick or cut gaskets shall be reworked to the approval of the Project Manager.

2. Prestressed Concrete Cylinder Pipe

No cutting of prestressed cylinder pipe will be allowed. All pipe which does not fit or close shall be rejected and the rejected pipe removed from the job site.

3. PVC Pipe

PVC pipe shall be cut using carpenter, hack saws or abrasive wheel. Care shall be taken to make all cuts square and perpendicular to the longitudinal axis of the pipe. After cutting, the Contractor shall bevel the ends of the pipe to approximate the manufactured bevel of a full length of pipe. Pipe which is not cut square or which has rough and jagged edges that might nick or cut gaskets shall be reworked to the approval of the Project Manager. When twelve (12) inch butterfly valves are called for on the plans for PVC pipe, the pipe ends shall be chambered on the inside radius as detailed in the Lincoln Standard Plans so that the valve operates to a fully closed position.

23.07 INSTALLATION OF PIPE FITTINGS (Continued)

C. PREVENTING CONTAMINATION

Existing valves and valves connecting the existing system to the new construction shall be operated only by the Lincoln Water System; except that the Contractor may operate those valves to fill the new mains for testing, only after notification of Lincoln Water System personnel.

The Contractor shall keep the pipe and appurtenances clean and free from tools, rags, dirt, mud, non-potable water, and other foreign materials and objects at all times during installation. If pipe laying is stopped or delayed for any reason, the Contractor shall plug the open ends of all pipes, Plugs shall be capable of preventing the entry of water and other foreign material with the excavation completely full of water.

All pipe shall be jointed immediately after placement in the excavation. Bells of pipe shall face in the direction of laying. The Contractor shall ensure that the pipe is not displaced after it is laid to the proper line and grade; and should the pipe become displaced the Contractor shall relay the pipe to the proper line and grade at no additional cost or expense to the City.

D. UTILITY CONFLICTS

Where unforeseen conflicts between the water construction and existing utilities are discovered, the Contractor shall immediately notify the Project Manager. Where the water main is to be constructed below or within 18 inches of any sewer pipe, the Contractor shall lay a full length of water main pipe centered on the sewer or such length as will provide the maximum possible separation of the joints in the water main from the sewer line. The Contractor shall also reconstruct any sanitary sewer with one (1) 20 foot length of pressure pipe material as provided in Section 22.02(B), such that the maximum possible separation between the water main and the sewer pipe joints will result. The backfill material shall be select, low-permeability soil.

Where existing water mains are to be looped around another utility, the Contractor shall plan his work so that disruptions to water service are minimized. The Contractor shall provide adequate personnel, equipment and materials necessary to complete the work as quickly as possible. All necessary materials shall be on site, and where ever possible, the Contractor shall preassemble the entire looping configuration, including bends or offsets and restraint devices, before the water main will be scheduled for shutdown by Lincoln Water System. Service fees charged by the Lincoln Water System shall be considered subsidiary to the cost of looping the water main in the event of a utility conflict. Additional fees for extended shutdowns shall not be cause for additional compensation to the Contractor.

E. THRUST RESTRAINTS

The Contractor shall construct concrete thrust blocks conforming to the requirements of the Lincoln Standard Plans at all locations shown on the plans or indicated by the Project Manager. All thrust blocks shall be placed so that pipe and fitting joints will be accessible for repairs. The bearing face of all thrust blocks shall rest against undisturbed soil. All hydrant drain holes and valve operators shall be protected from concrete during construction of the thrust blocks.

When the existing water mains must be reconstructed or looped, the Contractor shall restrain all fittings with ductile iron retainer glands installed in accordance with the manufacturer's recommendations in addition to concrete thrust blocks and/or anchorages.

F. TRACER WIRE

The Contractor shall install tracer wire in the trench adjacent to the pipe, with PVC pipe only. Tracer wire shall be extended to the ground surface and terminated in accordance with the Standard Plans using a coil of excess wire at least two (2) feet in length inside the termination box. Installation of tracer wire shall be considered subsidiary to the installation of PVC pipe. Tracer wires shall be tested for continuity after backfilling with a wire continuity tracing device. All wires failing to provide positive continuity for signal transmission shall be repaired or replaced at the Contractor's expense. After testing the ends, all tracer wires shall be sealed with heat shrink tape.

G. JOINTING PIPES

1. General

All bells, gaskets, lubricants and appurtenances shall be kept clean. Gaskets shall be of the proper style for the pipe being laid. Joints shall be deflected after assembly.

2. Ductile Iron Pipe

Bell ends shall be protected during joining by approved methods. Maximum pipe joint deflections for push-on and mechanical jointed pipe shall conform to the following:

Maximum Joint Deflections for Ductile Iron						
Pipe Diameter (Inches)	Push-on Joints			Mechanical Joints		
	Deflection Angle (Degrees)	Maximum Offset (inches)	Minimum Curve Radius (feet)	Deflection Angle (Degrees)	Maximum Offset (inches)	Minimum Curve Radius (feet)
6	4° 00'	17.0	285	4° 00'	17.0	285
8	4° 00'	17.0	285	4° 00'	17.0	285
12	4° 00'	9.5	285	4° 00'	9.5	285
16	2° 24'	9.5	475	2° 24'	9.5	475
24	2° 24'	9.5	475	2° 24'	9.5	475
30	2° 24'	9.5	475	2° 24'	9.5	475
36	2° 24'	9.5	475	2° 24'	9.5	475
48	1° 36'	6.5	715	1° 36'	6.5	715
54	1° 12'	5.0	955	1° 12'	5.0	955

3. PVC Pipe

PVC pipe shall be joined by inserting the spigot end of the pipe into the bell no further than marked by the manufacturer. Insertion on the PVC pipe further than the manufacturer's mark shall required reassembly. PVC pipe shall be installed in strict conformance to the manufacturer's requirements and instruction except that in no case shall PVC pipe be installed by bending the pipe. Bell ends shall be protected during joining by approved methods.

4. Mechanical Joints

Mechanical joints shall be assembled in strict conformance with the manufacturer's instructions and recommendations. Bolts on opposite sides of the joint shall be drawn up evenly to ensure even pressure around the gland and gasket. The Contractor shall tighten all retainer gland screw wedges according to manufacturer' recommendations for each type of retainer gland and pipe material. Prior to final tightening, the Contractor shall make any necessary deflections. Deflections for ductile iron pipe shall not exceed those shown in the following table:

5. Prestressed Concrete Cylinder Pipe Joints

The Contractor shall make all joints in prestressed concrete cylinder pipe in strict conformance with the manufacturer's instructions and recommendations. After placing the gasket on the spigot end of the pipe, the Contractor shall run a smooth round steel rod between the gasket and the spigot for one complete turn around the pipe and repeat in the opposite direction to ensure uniform stretching of the gasket.

After seating but prior to homing the pipe, the Contractor shall check the gasket for proper location using feeler gauges. Gaskets for pipes larger than 24 inches in diameter shall be checked from both the inside and outside of the pipe. Pipes shall be deflected where required after homing, according to the following:

Pipe Diameter (Inches)	Maximum Joint Opening (Inches)
6-36	3/4
48	1
54	1-1/8

The exterior joint recesses shall be filled with cement mortar. Cement mortar shall be rodded into diaper with a wire curved to conform to the radius of the pipe.

H. POLYETHYLENE ENCASEMENT

The Contractor shall double wrap and seal with tape all bolted connections, anchoring couplings, anchoring elbows, valves, and fire hydrants. The Contractor shall ensure that hydrant drain holes are not blocked or covered. The Contractor shall wrap all service pipes from the tap extending 3 feet (1 m) away from the main, and shall repair all polywrap at the tap location. When called for on the plans, the Contractor shall also double wrap the entire pipe in polyethylene encasement. Whenever PVC or other pipe is used or specified, all cast iron or other metallic fittings and appurtenances shall be double wrapped in polyethylene encasement.

All polyethylene encasements shall be installed using Methods A or B as detailed in ANSI A21.5.

I. WATER MAIN SHUTDOWNS

All water main shutdowns shall be performed by Lincoln Water System personnel upon request from the Contractor.

At least forty eight (48) hours prior to the time that tapping, valve operation, flushing or disinfection services are required, the Contractor shall notify the Assistant Superintendent of Water Construction or his representatives to provide for scheduling such services. These services shall be scheduled only during normal City working hours.

Additional notice shall be required when critical water customers such as industries, schools, day cares, medical facilities, etc are impacted by the shutdown. Interruptions of water service to critical customers may require work to be performed after normal work hours or on weekends. The Lincoln Water System shall notify the Contractor when critical customers are connected to the water main planned for shutdown.

Service fees charged for water main shutdowns shall be considered subsidiary to the cost of installation of the water main or the cost of the reconstructing or looping the water main or water services in the event of a utility conflict

BASIS OF PAYMENT

The installation and jointing of pipe and fittings will not be measured or paid for separately. Cost of this work shall be merged with and considered subsidiary to the cost of the various pipes and fittings for which direct payment is made.

Unless otherwise specified, polyethylene encasements shall not be measured and paid for separately. The cost of polyethylene encasement shall be considered subsidiary to the cost of those items for which direct payment is made.

DUCTILE IRON PIPE WATER MAIN of the various types and sizes called for on the plans shall be measured and paid for at the contract unit price bid per linear foot for each different diameter required. Pipe shall be measured through fittings and valves. Such payment shall be full compensation for all excavation, backfill, pipe, other materials, testing, equipment, tools, labor and incidentals necessary to complete the work in accordance with these Specifications and as accepted by the Project Manager.

POLY VINYL CHLORIDE (PVC) WATER MAIN of the various types and sizes called for on the plans shall be measured and paid for at the contract unit price bid per linear foot for each different diameter required. Pipe shall be measured through fittings and valves. Such payment shall be full compensation for all excavation, backfill, pipe, bedding material, other materials, testing, equipment, tools, labor, and incidentals necessary to complete the work in accordance with these Specifications and as accepted by the Project Manager.

ALL CAST IRON AND DUCTILE WATER MAIN FITTINGS, including ductile iron compact fittings, shall be measured separately and shall be paid for at the contract unit price bid per each for the various fittings called for in the proposal.

Glands, bolts, nuts and gaskets necessary to complete a non-restrained mechanical joint connection for water main fittings are considered accessory items to the connection. No direct payment shall be made for these items, but are considered subsidiary to CAST IRON AND DUCTILE IRON WATER MAIN FITTINGS for which payment is made.

RETAINER GLANDS of the various sizes called for to complete a restrained mechanical joint connection for water main fittings shall be counted and paid for at the contract unit price bid per each. All work shall be in conformance with these Specifications and accepted by the Project Manager.

CONCRETE FOR THRUST BLOCKS AND ANCHORAGES shall not be measured for payment. Payment will be based on the concrete volumes shown on the Lincoln Standard Plans for thrust blocks and anchorages actually installed and will be made at the contract unit price bid per cubic yard for blocks constructed in conformance with the drawings, these Specifications, and accepted by the Project Manager..

REINFORCING STEEL FOR THRUST BLOCKS AND ANCHORAGES will not be measured for payment. Payment will be based on the weights shown on the Lincoln Standard Plans for thrust blocks and anchorages actually installed and will be made at the contract unit price bid per pound for blocks constructed in conformance with the drawings, these Specifications, and accepted by the Project Manager.

23.08 INSTALLATION OF VALVES AND HYDRANTS

Immediately prior to installation, the Contractor shall inspect all valves and hydrants to ensure they are in good operating condition and free from defects. All valves shall be installed in such a manner that the operating nut and key will be in a vertical position. When the operator is located on the side of the valve, the Contractor shall install the valve with the operator located on the curb side of the valve.

Valves 12 inches in diameter and larger shall be installed resting on one or more precast concrete support blocks 18 inches square and 4 inches thick which bear against undisturbed earth.

The Contract shall check the installation of all butterfly valves to be certain that the valve can be operated throughout its entire range of operation, and that it does not have contract with the inside edges of the pipe when operating.

Where tapping sleeves and valves are to be installed, the Contractor shall make all excavations to the dimensions required and provide all necessary trench protection. The Contractor shall provide precast concrete pads and other stabilizing materials under the tapping valves necessary to prevent rotation of the tapping sleeve on the main.

The Contractor shall provide and install a valve box over every valve operator. The valve box shall be installed plumb and centered over the operating nut and with the bottom of the box sufficiently lower than the operating nut to prevent the entry of soil. The top of the box shall be set flush with the final grade or paved surface. Valve box adjusting rings shall not be used to adjust valve boxes to grade.

Hydrants shall be set plumb, resting on a precast concrete pad, 4 inches thick and 18 inches square. The support pad shall rest against undisturbed earth. The top of the flange on the hydrant shall be set to the grade shown on the plans. A hydrant of the length shown on the plans shall be used to attain this elevation. The Contract shall make appropriate deflections or rotations in the tee and anchoring elbow, or use an anchoring offset, to meet this grade. Where a hydrant extension is necessary to meet the required grade, the hydrant extension shall be installed only by LWS. Only one extension will be permitted on a hydrant. The Contractor shall remove and reset all hydrants which cannot be adjusted to grade with one extension. The Contractor shall notify the Project Manager or that person's representative when hydrant extension are required.

The Contractor shall place a minimum of 2 cubic feet of hydrant drain material around the base of the hydrant to allow free ready drainage of the barrel.

23.08 INSTALLATION OF VALVES AND HYDRANTS (Continued)

When obtaining hydrants from the Lincoln Water System, the Contractor shall determine and select the hydrant shoe configuration that best suits proper orientation of the steamer (large) nozzle perpendicular to the curb line. When required, adjustments to the final hydrant nozzle orientation shall be made by the Lincoln Water System with all applicable costs and fees accessed to the Contractor. These fees shall be considered subsidiary to the cost of installing t he water main and shall not be cause for additional compensation by the Contractor.

Backfill shall be accomplished in accordance with the provisions of Chapter 20 of these Specifications, except that all backfill within 3 feet of all hydrants and valve boxes shall be compacted to 95% of maximum dry density as measured by AASHTO Method T-99.

BASIS OF PAYMENT

All VALVES of the various types and sizes indicated on the plans and actually installed shall be counted and paid for at the contract unit price bid per each. Such price shall include the valve, valve box, support blocks, other materials and labor necessary to install the valves, all equipment, tools, and incidentals necessary to complete the work in accordance with these Specifications and as accepted by the Project Manager.

All HYDRANTS installed, as shown on the plans or as directed, except temporary hydrants used for flushing or disinfection of the mains, shall be counted and paid for at the contract unit price bid per each for HYDRANT, COMPLETE, L=5.5 feet or L=6.5 feet. Such price shall be full compensation for all loading, hauling, installation, thrust blocking, hydrant drain material, hydrant extensions, backfilling, labor, tools, materials, equipment and incidentals necessary to complete the work in accordance with these Specifications and as accepted by the Project Manager. Temporary hydrants used for flushing and disinfection of mains shall be not be paid for separately but shall be considered subsidiary to the installation of the mains.

All HYDRANT EXTENSIONS necessary to adjust the hydrants to grade shall be counted and paid for at the contract unit price bid per each for HYDRANT EXTENSION, COMPLETE. Such price shall be full compensation for all installation costs charged by LWS, hydrant extension kits, labor, tools, materials, equipment and incidentals necessary to complete the work in accordance with these Specifications and as accepted by the Project Manager. The unit price for HYDRANT EXTENSION, COMPLETE shall be an established unit price per each in the bid proposal.

23.09 TEMPORARY HYDRANTS AND BLOW-OFF FOR FLUSHING AND DISINFECTION

Temporary hydrants and blowoffs shall be provided as shown on the plans or as determined by the Lincoln Water System to provide adequate discharge of water for preliminary and final flushing of the water main(s) in accordance to AWWA C651. The installation of temporary hydrants and blowoffs shall include any necessary protection of surrounding areas from damage caused by water erosion and any other provisions necessary for the conveyance of discharge water to protect of downstream facilities or property.

The installation of temporary hydrants and blowoffs, necessary erosion protection, discharge water conveyance and downstream protection and the removal of temporary hydrants and blowoffs shall be subsidiary to the cost of water main installation.

23.10 WATER SERVICE CONSTRUCTION OR RECONSTRUCTION

For the purpose of constructing or reconstructing all water supply and service lines, the Contractor shall comply with the provisions of Title 17 of the Lincoln Municipal Code. The Contractor shall cause all work to be performed by a licensed plumber. All water services that are uncovered in the course of construction shall be inspected by the Lincoln Water System to assess their integrity and recommend replacement to customers when found to be in unsatisfactory condition. All water services that are reconstructed shall be inspected by the Lincoln Water System.

23.10 WATER SERVICE CONSTRUCTION OR RECONSTRUCTION (Continued)

All water supply or service lines which are to be looped or reconstructed shall be constructed of Type "K" seamless soft-drawn copper tubing or ductile iron pipe.

The Contractor shall place all reconstructed water services or looped water services so as to provide a minimum cover of 5 feet. Minimum lateral clearance from structures open to the weather, such as storm sewer inlets, shall be 3 feet. All other clearance shall be a minimum of 6 inches.

The Contractor shall place all reconstructed water services or looped water services so as to provide a minimum cover of 5 feet. Minimum lateral clearance from structures open to the weather, such as storm sewer inlets, shall be 3 feet. All other clearance shall be a minimum of 6 inches.

Looping a water service shall consist of the reconstruction of a water service across the width of the excavation for the facility being built or within 5 feet of said excavation. When the break in the service line is within 5 feet of either the tap or the curb stop, the Contractor shall loop the service pipe from the tap or curb stop to the opposite side of the excavation and only one (1) joint will be allowed. When the break in the service line is beyond 5 feet from the tap or curb stop, the Contractor shall loop only that portion of service within the excavation and 2 joints will be allowed. All joints shall be located at or near the edges of the excavation and in no case shall the joints be positioned beneath other pipes or structures.

When a service constructed of lead, galvanized steel, pitted copper, or other material considered unacceptable according to Title 17 of the Lincoln Municipal Code requires looping or reconstruction, the entire service from tap to curb stop shall be replaced.

When a water service which does not conflict with the work is damaged by the Contractor, it must be repaired or replaced at the expense of the Contractor to the Project Managers satisfaction. Copper service pipe in good condition may be repaired, all other unacceptable service materials shall be replaced from tap to curb stop.

When a service is replaced to the corporation tap, a new tap may be required. No tap shall be allowed to remain which is smaller than 3/4inch.

New curb stops and boxes may be required when the service is reconstructed to the curb stop. Such curb stop may be ordered replaced because of inoperable or obsolete. All curb stops and boxes shall be supplied by the Lincoln Water System at no cost to the Contractor.

All corporation taps, labor and equipment required to replace taps will be supplied by the Lincoln Water System to the Contractor at no cost. The Contractor shall be responsible for all excavation, boring, backfilling, installation of curb stops and boxes, sod, pavement, and other incidentals necessary to complete the looping or reconstruction.

All water services crossing or paralleling a new main shall be transferred to the new main if the main is 16" or smaller.

Any tap removed from service shall be immediately abandoned at the main by the Lincoln Water System at no cost to the Contractor. The Contractor shall be responsible for excavation, backfill, sod, pavement and other incidentals necessary to complete the abandonment.

BASIS OF PAYMENT

When the items of work stated below do not appear as bid items in the proposal form, all work necessary for the looping or reconstruction of water services shall be paid for as an extra work item.

When the items of work stated below are included in the proposal form, the payment shall be as follows:

COPPER WATER SERVICE PIPE or DUCTILE IRON WATER SERVICE PIPE of the various sizes called for shall be measured and paid for at the contract unit price bid per linear foot. Such payment shall be full compensation for all materials, tools, equipment, labor including the licensed plumber, excavation, backfill, sod, clean-up and incidentals necessary to install the pipe in a manner acceptable to the Project Manager.

Boring for water service pipe shall be measured and paid for at the contract unit price per linear foot for BORING FOR WATER SERVICE PIPE. Such payment shall be full compensation for all labor, materials, equipment, tools and incidentals necessary to produce the bore hole ready to receive the water service pipe, as accepted by the Project Manager. Water service pipe to be placed in the bore hole shall be paid for as provided above.

LOOP WATER SERVICE shall be measured and paid for at the contract unit price bid per each. This payment shall be full compensation for all labor, equipment, excavation, backfill, tools, incidentals, and materials except pipe, necessary to complete the work in a manner acceptable to the Project Manager.

CONSTRUCT OR RECONSTRUCT WATER SERVICE shall be measured and paid for at the contract unit price bid per each. Such payment shall be full compensation for all labor, tools, materials except pipe and materials supplied by the City, equipment, excavation, backfill and incidentals necessary to complete the work in a manner acceptable to the Project Manager.

23.11 ABANDONMENT OF WATER MAIN (IN PLACE)

When existing water mains are shown to be abandoned in place on the plans, the Contractor shall turn all valves to the off position, remove one (1) or more feet of the top section of the valve box, fill with sand and cap or plug with concrete, and plug each end of the abandoned water main segment with concrete. ABANDONMENT OF WATER MAIN (IN PLACE) shall be measured and paid for at the contract lump sum amount. Such payment shall be full compensation for all labor, tools, and materials necessary to complete the work in a manner acceptable to the Project Manager.

23.12 HIGHWAY, STREET AND RAILROAD CROSSING

Highway, street and railroad crossings shall be constructed as indicated on the plans and as specified in the respective permits issued, if applicable. The City will obtain all necessary permits. Pipe encasement shall be constructed in conformance with Chapter 20 of these Specifications.

23.13 TESTING

The Contractor shall furnish all gauges, pumps and other equipment necessary to perform all of the acceptance tests and shall provide all assistance necessary or required by the Project Manager to verify the test results. No test shall be conducted until all thrust blocking has attained sufficient strength to resist any thrusts imposed by the test pressures applied.

The Contractor shall carefully fill the main or mains to be tested with water from the existing water distribution system. The Contractor shall bleed all air from pipes, valves, fittings and hydrants during filling operations. All corporation stops required to expel air shall be installed by the Lincoln Water System. The Contractor shall provide and backfill all excavations required to install corporation stops. All air taps will be abandoned by the Lincoln Water System personnel after testing is completed.

23.13 TESTING (Continued)

The Contractor shall pump water into the system to raise the pressure to the level indicated in the table below at the lowest elevation in the section being tested. The Contractor shall maintain the test pressure for a minimum of two (2) hours, carefully measuring all water added to the system during that period. The rate of water added per 1,000 feet of pipeline shall not exceed the following:

Nominal Pipe Size (inches)	Maximum Allowable Rate (gallons/hour)	Test Pressure (psi)
6	0.64	200
8	0.85	200
12	1.28	200
16	1.47	150
24	2.21	150
30	2.76	150
36	3.31	150
48	4.41	150
54	4.97	150

When the pipeline being tested contains sections of various diameters, the allowable losses shall be the sum of the computed allowable losses for each size. Where sections are isolated for testing, the allowable losses will be computed for the length of sections being isolated.

During the test period, the ground surface along the length of the section being tested shall be examined for leakage. All detected leaks shall be repaired regardless of the test results.

In the event that the test requirements are not met, the Contractor shall locate and repair all defects at his own expense. Following the repairs, the tests shall be repeated until the test result requirements are met.

Pressure testing shall not be measured for paid for directly. Testing shall be considered subsidiary to those items for which direct payment is made.

23.14 DISINFECTION OF THE COMPLETED WORK

The Contractor shall keep the work clean during construction to facilitate disinfection. All excavation and backfill required to install chlorination taps shall be provided by the Contractor

For water mains 24 inch and smaller, the Contractor shall provide for the scheduling of the flushing and disinfection by the Lincoln Water System at least twenty-four (24) hours in advance of the time that those services are desired. All costs of disinfection, including tests, shall be billed to and paid for by the Contractor.

23.14 DISINFECTION OF THE COMPLETED WORK (Continued)

For water mains 30 inch and larger, the Contractor shall provide a flushing and disinfection plan to the Project Manager for review and approval that is in conformance to the Special Provisions or the requirements specified in AWWA C651. This plan shall include the method and disinfectant to be used in disinfection process, the concentration of disinfectant to be used, the method of neutralization of the disinfectant prior to discharge into open channels or storm sewer systems. The documented results of the bacteriological tests shall be provided to the Project Manager with a copy to the Lincoln Water System.

Flushing and disinfection will be repeated at the Contractor's expense until bacteriological tests conducted by the Lincoln Water System indicate the system is properly disinfected.

The work required to disinfect the system shall not be measured for direct payment. Disinfection shall be considered subsidiary to those items for which direct payment is made

23.15 COLD WEATHER CONSTRUCTION

All construction performed in cold weather or during periods where frost penetration of the soil exceeds 6 inches shall be in accordance with Chapter 20 of these Specifications.

23.16 SUBSTANTIAL COMPLETION

Water main work shall be considered substantially complete when all pipe is laid, all hydrants, valves, fittings and appurtenances installed and operable, backfill complete, testing complete and accepted, disinfection complete, tap holes backfilled, water services connected, paving, sidewalks and driveways replaced, final clean-up and park space finished.

23.17 FINAL COMPLETION AND ACCEPTANCE

The project shall be considered eligible for final acceptance by the City when all required work is complete and accepted by the Project Manager, including all work associated with existing water main abandonment, valve box grade adjustments, required grade adjustments to hydrants including installation of hydrant extensions in accordance to these specifications, required adjustments to hydrant nozzle orientation, seeding and/or sodding, and correction of all deficiencies found as a result of testing and/or final inspection by the Project Manager.

23.18 GUARANTEE

At any time during the two year guarantee period, and within the time period allowed, the Contractor shall correct any defect in material or workmanship which has been brought to his attention. Such items shall include but not be limited to trench settlement including subsequent pavement damage, pipe leaks, damage to polyethylene encasement, hydrants out of plumb, hydrants which drain improperly, valve boxes out of plumb or offset from center of operating nut, or service line leaks.